

CLAIMS

It is claimed:

1. An apparatus for spotting a reagent on one or more substrates, comprising in operative condition:
 - a base adapted to hold such a reagent;
 - a conveyor having a surface with a plurality of spaced, tandemly-arranged substrate-support regions, each adapted to support such a substrate, said conveyor being operable to advance such substrates along a transport pathway over said base; said conveyor surface defining an opening between each adjacent pair of substrate-support regions;
 - a transfer head having a spotting tip, said tip being mounted for movement along an axis, toward and away from a raised position at which the tip is disposed above the conveyor surface;
 - an actuator operatively connected to said tip for moving the same along said axis; and
 - a control unit operatively connected to the conveyor and actuator, operative, for one or more selected substrates on the conveyor surface, to (i) shift said tip away from its raised position through a selected opening in said conveyor surface to contact reagent in said base, (ii) withdraw said tip from the reagent and through the opening by shifting the tip toward its raised position, and (iii) shift said tip away from its raised position toward a selected substrate upstream of the selected opening, to transfer a selected amount of reagent from said tip to a selected region of the selected substrate.
2. The apparatus of claim 1, which further includes one or more additional transfer heads and associated actuators disposed at spaced positions along said transport pathway, and structure in said base adapted to hold one or more reagents at each of said spaced positions.

3. The apparatus of claim 2, wherein at least one of said transfer heads is laterally offset from the other transfer heads.

4. The apparatus of claim 2, wherein a plurality of transfer heads are disposed in a row extending laterally or obliquely across the conveyor surface at one or more of said spaced positions along said transport pathway.

5. The apparatus of claim 1, further comprising a channel extending through at least a portion of said base.

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6. The apparatus of claim 5, further comprising a flow line having an outlet disposed to direct a selected fluid into said channel.

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7. The apparatus of claim 6, wherein said base is adapted to hold one or more reagent reservoirs such that a lower region of each reservoir extends at least partially into said channel.

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8. The apparatus of claim 6, wherein said transfer tip, when shifted away from its raised position with said axis unobstructed, can enter at least partially into said channel.

9. The apparatus of claim 1, wherein said tip is a pin having a distal end less than about 500 μm in diameter.

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10. The apparatus of claim 1, wherein said tip includes a channel of capillary size adapted to draw in reagent, when shifted into contact therewith, by way of capillary action.

11. The apparatus of claim 1, wherein said tip is a micropipette.

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12. The apparatus of claim 1, wherein said transfer head includes a plurality of spotting tips mounted side-by-side, in spaced relation; each tip being adapted for movement along a respective axis, toward and away from a raised position at which the tip is disposed above the conveyor surface.

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13. The apparatus of claim 1, wherein an elongate web defines said conveyor surface, with each of said substrate-support portions defining a substrate suitable for spotting.

10 14. The apparatus of claim 13, wherein said web material is a flexible membrane material.

15. The apparatus of claim 1, wherein an elongate flexible belt defines said conveyor surface.

16. An apparatus for spotting a reagent onto one or more substrates, comprising:

a conveyor belt comprising a plurality of substrate-support regions separated from one another by intervening open regions therebetween;

5 a base located beneath the conveyor belt for supporting one or more reagent reservoirs;

a transfer head, disposed above said base and said conveyor belt, which has a reagent spotting tip mounted for movement between (1) a raised position above the conveyor belt, (2) a reagent dispensing position for depositing reagent

10 on a substrate carried by one of said substrate-support regions, and (3) an extended position below the conveyor belt which is achieved by passing the tip through one of said open regions;

means for moving the conveyor belt along a transport pathway such that the substrate-support regions pass between said base and said transfer head;

15 means for shifting the spotting tip between said extended, reagent dispensing, and raised positions; and

one or more controllers operatively connected to the moving means and shifting means effective to (i) shift the spotting tip from its raised position to its extended position by traversing a selected open region in said conveyor belt, for

20 withdrawing reagent from a reservoir supported by the base, (ii) raise the spotting tip after step (i) to a position above the conveyor belt, (iii) move the conveyor belt

so that a selected substrate is positioned below the raised spotting tip, (iv) move the spotting tip to a reagent dispensing position so that reagent is deposited onto a selected region of the selected substrate, (v) after reagent deposition, raise the

25 spotting tip to its raised position, (vi) move the conveyor belt so that the spotting tip is positioned above another open region, and (vii) repeat steps (i) through (vi) a selected number of times.

17. An apparatus for spotting a reagent on one or more substrates, comprising in operative condition:

- a base adapted to hold such a reagent;
- 5 a conveyor having a surface defining (i) a plurality of spaced, tandemly-arranged substrate regions, and (ii) an opening between each adjacent pair of substrate regions; said conveyor being operable to advance such regions along a transport pathway over said base;
- 10 a transfer head having a spotting tip, said tip being mounted for movement along an axis, toward and away from a raised position at which the tip is disposed above the conveyor surface;
- 15 an actuator operatively connected to said tip for moving the same along said axis; and
- a control unit operatively connected to the conveyor and actuator, operative, for one or more selected substrate regions defined by the conveyor 20 surface, to (i) shift said tip away from its raised position through a selected opening in said conveyor surface to contact reagent in said base, (ii) withdraw said tip from the reagent and through the opening by shifting the tip toward its raised position, and (iii) shift said tip away from its raised position toward a selected substrate region upstream of the selected opening, to transfer a selected amount of reagent from said tip to a selected site of the selected substrate region.

18. The apparatus of claim 17, wherein said conveyor surface is a flexible web material.

19. A method for spotting a reagent on one or more substrates, comprising the steps of:

(i) advancing a plurality of spaced, tandemly-arranged substrates along a transport pathway extending over a reagent-supply location;

5 (ii) from a position over said reagent-supply location and said pathway,

(a) extending a reagent-transfer instrument through an intervening region separating an adjacent pair of advancing substrates to contact reagent held at said reagent-supply location,

(b) withdrawing the reagent-transfer instrument, along with a

10 portion of such reagent, through said intervening region to a position above said transport pathway, and

(c) transferring a selected amount of reagent from said reagent-transfer instrument onto a selected region of a selected substrate upstream of said intervening region.

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20 20. The method of claim 19, wherein said substrates are integrally formed as spaced-apart expansive portions provided along an elongate web material, and each of said intervening regions is an opening formed through said web material between adjacent substrate portions.

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21. The method of claim 19, wherein said substrates are advanced using a conveyor having a movable belt with a plurality of tandemly-arranged substrate-support regions; with each substrate being placed at a defined location on a respective one of said substrate-support regions.

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22. The method of claim 19, wherein said transport pathway extends over a plurality of reagent-supply locations, disposed at spaced positions along said pathway; and wherein step (ii) is performed at two or more of said spaced positions in a fashion effective to produce a plurality of reagent spots on the

30 selected substrate.

23. The method of claim 22, wherein at least one of said reagent spots on the selected substrate is laterally offset from the other reagent spots.

24. The method of claim 22, wherein step (ii) is performed at least twice, in a substantially parallel fashion, using separate reagent-transfer instruments at one or more of said spaced positions.

25. The method of claim 19, further comprising the steps of:
removing any reagent(s) being held at said reagent-supply location;
extending at least a portion of said reagent-transfer instrument into said reagent-supply location;
flowing a cleaning fluid along said reagent-supply location so that it contacts and cleans said reagent-transfer instrument.

26. The method of claim 25, further comprising the step of:
with at least a portion of said reagent-transfer instrument extended into said reagent-supply location, flowing a gas along said reagent-supply location so that it contacts and dries the cleaned reagent-transfer instrument.

27. The method of claim 19, further comprising the steps of:
placing a vessel containing a selected liquid reagent at said reagent-supply location; and
flowing a cooling fluid along said reagent-supply location so that it contacts said vessel, thereby reducing evaporative loss of the selected liquid reagent.

28. The method of claim 19, further comprising the steps of:
prior to step (i), retrieving a vessel containing a selected reagent from a storage location, and placing the vessel at said reagent-supply location; and
subsequent to step (ii), retrieving the vessel from said reagent-supply location, and returning the vessel to its storage location.